

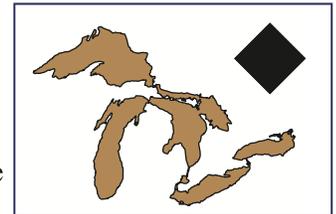
State of the Great Lakes 2005

Highlights



Overall Assessment of the Great Lakes

This report summarizes information on the status of the Great Lakes basin ecosystem drawn from the *State of the Great Lakes 2005* report. Indicator reports presented at the State of the Lakes Ecosystem Conference (SOLEC) held in Toronto, Ontario, in October 2004, are used to form the basis of both the Highlights and the *State of the Great Lakes 2005* reports. Fifty-six indicators under the following nine categories were assessed: **Human Health, Land Use-Land Cover, Contamination, Biotic Communities, Invasive Species, Aquatic Habitats, Coastal Zones, Resource Utilization and Climate Change**. In addition, each lake basin, the St. Clair River-Lake St. Clair-Detroit River ecosystem and the St. Lawrence River were also assessed using available information.



Every two years, in accordance with the requirements of the Great Lakes Water Quality Agreement, the Great Lakes community reports on the condition of the Great Lakes ecosystem at SOLEC using a consistent set of indicators. Indicators are measures of ecosystem and human health that help us determine whether management activities are successful or are in need of change. Almost every indicator report is replete with scientific information collected and assessed by Great Lakes experts from both Canada and the United States. Authors of these indicator reports have assessed ecosystem conditions based on a combination of data collected, a review of scientific papers and best professional judgment.

Overall, the combined expertise of more than 150 scientists and natural resource managers led to the assessment that the state of the Great Lakes ecosystem is **mixed**, with areas and conditions that are good and other areas that are in poor condition. The trend of Great Lakes ecosystem health remains **unchanged**, i.e. some conditions are getting better while others are getting worse.

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Great Lakes and Rivers

State of the Lakes Ecosystem Conference

Photo Credit: U.S. Environmental Protection Agency, Great Lakes National Program Office

ISBN 0-662-41451-9
 Cat. No. En161-3/2005E
 EPA 905-F-05-006

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The following colour and symbol guide is used throughout the report to provide the reader with a clear assessment of the indicators highlighted in this document.

Status

-  **Good.** The state of the ecosystem component is presently meeting ecosystem objectives or otherwise is in acceptable condition.
-  **Fair.** The ecosystem component is currently exhibiting minimally acceptable conditions, but it is not meeting established ecosystem objectives, criteria or other characteristics of fully acceptable conditions.
-  **Poor.** The ecosystem component is severely negatively impacted and it does not display even minimally acceptable conditions.
-  **Mixed.** The ecosystem component displays both good and degraded features.

Trend

-  **Improving.** Information provided by the report shows the ecosystem component to be changing toward more acceptable conditions.
-  **Unchanging.** Information provided by the report shows the ecosystem component is neither getting better nor worse.
-  **Deteriorating.** Information provided by the report shows the ecosystem component to be changing away from acceptable conditions.
-  **Undetermined.** Data are not available to assess the ecosystem component over time, so no trend can be identified.



Ecosystem Assessment

Assessments vary among indicators, indicator categories and lake basins. Every effort has been made to include the most up-to-date information. Development of relevant indicators, along with increased and co-ordinated monitoring across the basin, is ongoing and expected to improve the ability of experts to assess ecosystem and human health conditions in the Great Lakes basin.

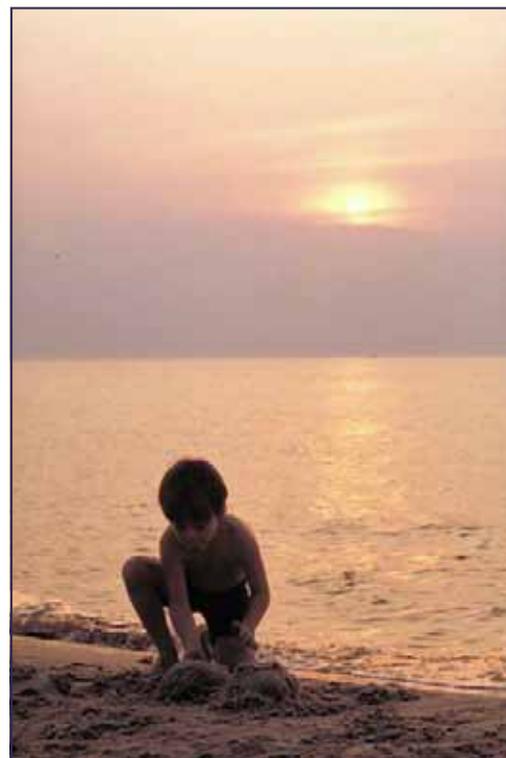


Photo Credit: U.S. Environmental Protection Agency, Great Lakes National Program Office

Management Challenges

Several management challenges, highlighted below, were identified and discussed through the SOLEC process, including: a special session of Great Lakes environmental managers; comments provided by SOLEC participants; and challenges reported in the lake, river and indicator assessment reports. The management challenges focus on the protection and restoration of the Great Lakes basin, including land use, habitat degradation and loss, climate change impacts and toxic contamination. The management challenges also consider future potential impacts of chemicals of emerging concern, non-native species and the inevitable stress from an increasing human population.

Land Use

Management Challenge: What land use practices will sustain the ecosystem over the long term, thereby contributing to improvements in the quality of land and water?

Current **land use practices** throughout the basin are affecting the chemical, physical and biological aspects of the ecosystem, including the quality of land, water and the quality of life for all biota. Each lake and river assessment presented in the *State of the Great Lakes 2005* report cited the need for improved land use practices to counter the effects of urban sprawl and population growth. There is a need to demonstrate and encourage environmentally-friendly land use practices, e.g., strategically locate urban growth to limit the impact on habitat, air and water quality. Enlightened managers (whether private land owners and developers or public service employees) should seek assistance from the many planning tools and decision support systems that are currently available.

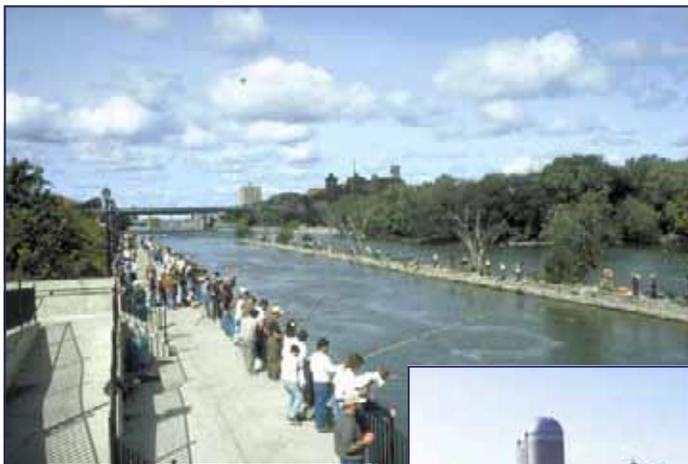


Photo Credit: U.S. Environmental Protection Agency, Great Lakes National Program Office



Photo Credit: D. Breneman, Minnesota Extension Service

Habitat Degradation and Loss

Management Challenge: How can essential habitats be protected and restored to preserve the species and the unique and globally significant characteristics of the Great Lakes ecosystem?

Many factors, including the spread of **non-native species, urbanization and population growth**, degrade and decrease the amount of habitat available for plants and animals. Native mussel species are facing extinction due to pressures from non-native zebra and quagga mussels. Hydrological alterations are impacting the functioning of wetland habitats and poorly planned development (as discussed in the Land Use section above) is degrading or destroying essential habitats and migration corridors. Defining and identifying essential habitats in the Great Lakes are critical, along with actions that promote ecological protection and restoration in the basin. Managers need current data and research to determine appropriate ecological protection and restoration tools and technologies, including the ability to identify the location, viability and amount of habitat required to sustain a particular species. Monitoring programs to understand species trends and educational programs that provide the public with a broad spectrum of actions to assist with the preservation of species' habitats are also required.

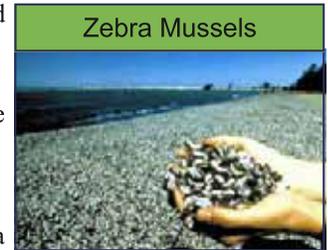


Photo Credit: U.S. Environmental Protection Agency, Great Lakes National Program Office

Climate Change

Management Challenge: Given the findings of climate change research, how will managers prepare for potential climate change impacts?

Studies suggest that the **climate** in the Great Lakes region is **changing**. Climate change has the potential to impact Great Lakes water levels, water and air temperatures, ice duration on the lakes, the amount and type of precipitation, habitats for biological diversity and human land uses, such as agriculture and forestry. In order to adapt to the impacts of a changing environment, managers need to consider climate change in **long-term planning** (including investments in infrastructure, public health, coastal development, etc). A challenge is to evoke management action to prepare and adapt to the potential impacts of a changing climate.

Toxic Contamination

Management Challenges:

- How will the economic and practical issues of continuing the removal of toxic contamination from our ecosystem be addressed?
- How will we determine when, and to what extent, to monitor specific chemicals and those of emerging concern?

The Great Lakes community **achieved significant progress** in its more than 30-year effort to remediate toxic contamination in water, fish, wildlife, sediments, air and people. Loadings of contaminants to the lakes have been dramatically reduced from their peaks in the 1970s, **although problems still exist**. Reductions in non-point source runoff have been significant, but optimal reductions have yet to be achieved. Adopting alternative agricultural practices to reduce runoff of pesticides and fertilizers may require a mix of approaches, including voluntary measures and incentives. Controls on industrial emissions of contaminants have been legislated and enforced, resulting in reductions in levels of contaminants in the environment. A management challenge is to continue to remove toxic contamination and excess nutrients economically and practically from the ecosystem, and to prevent additional



Photo Credit: U.S. Environmental Protection Agency, Great Lakes National Program Office

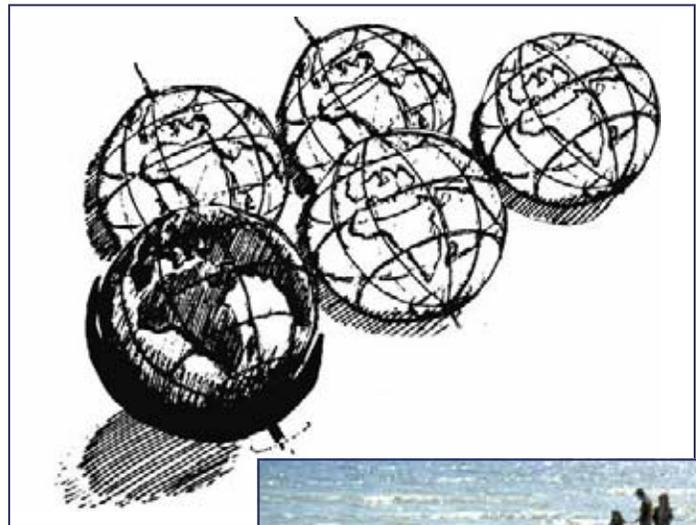
loads to the system. There are currently several studies in the Great Lakes basin investigating the presence of brominated flame retardants. These compounds are added to consumer products in an effort to reduce fire-related injury and property damage. The health effects of multiple contaminants, including endocrine disrupting chemicals, pharmaceuticals and other chemicals of emerging concern, need to be addressed.

Reporting on Indicators

Given the large number of indicators needed to assess the status of the Great Lakes basin ecosystem, how can the findings be sorted and interpreted in a way that is expedient and productive for managers? Indicator categories are one way to convey ecosystem status to Great Lakes managers and to the public. Managers may use a compilation of indicator information to make appropriate management decisions, or to interpret better the information presented in the *State of the Great Lakes* reports. A challenge is to find a method for compiling or indexing groups of indicators in such a way that it leads to more informed management decision-making. The indicators in the *State of the Great Lakes 2005* report were organized into nine categories and overall assessments were prepared for some of these categories. The overall category assessments, found on the following pages, were based on the individual indicator assessments and information within that category.

The current set of categories does not exclude the possibility of reorganizing indicators into different categories or indices to meet a manager's needs. For example, one approach to analyze the resource utilization category is the "Ecological Footprint." One of the originators of the approach, Dr. William Rees (*Our Ecological Footprint*, 1996), estimated that the footprint of the Great Lakes basin, or the area of Earth required to support the current lifestyle of Great Lakes basin citizens, would be equivalent to more than five times the actual area of the basin. In other words, if every person on earth today enjoyed the same type of lifestyle that most Great Lakes basin citizens enjoy, we

Source: William E. Rees, University of British Columbia



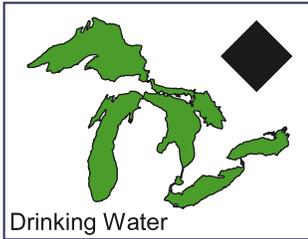
would need an additional four earth-like planets to accommodate everyone sustainably! Similar "index"-type approaches may be reported in future *State of the Great Lakes* reports.



Photo Credit: U.S. Environmental Protection Agency, Great Lakes National Program Office

Human Health

In general, human health-related conditions in the Great Lakes are improving. Polychlorinated biphenyls (PCBs) in fish continue to decline, biological markers of human exposure to contaminants are better assessed, progress is being made to reduce air pollution, beaches are better assessed and more frequently monitored, and drinking water quality continues to be good - that is, safe to drink.



Treated **drinking water** quality is safe to drink. It is unknown to what extent new pressures such as chemicals of emerging concern and non-native species will impact water treatment technology. Urbanization and sprawl are negatively affecting the quality and quantity of groundwater, which is an important source of drinking water for many basin residents.



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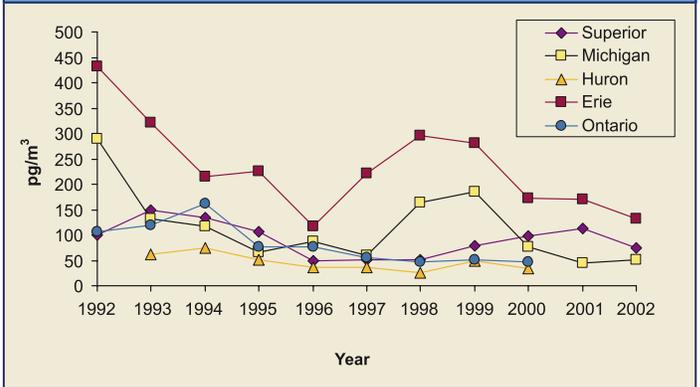


Beaches are generally safe for swimming. Contamination from sediments, combined sewer overflows, wildlife and livestock operations are the primary sources of bacteria (E. coli) in the water, causing beach postings or closures. Information for the 2003 swimming season showed that for more than 900 beaches which are monitored in both countries, 69 percent of Great Lakes beaches were open throughout the entire swimming season. Nevertheless, the public is advised to heed current public health advisories. Due to the nature of lab analyses, each set of beach water samples requires an average of one to two days before the results are available and communicated. New testing methods that will provide prompt E. coli results are needed so that beach information is relayed to the public quickly and effectively.

Air is a primary pathway by which persistent bioaccumulative toxic chemicals reach the Great Lakes. Once they reach the lakes they can, and do, bioaccumulate in fish and wildlife. Concentrations and loadings of banned or restricted toxic chemicals (PCBs and banned organochlorine pesticides such as dichlorodiphenyltrichloroethane, commonly known as DDT) and concentrations of dioxins and furans are generally decreasing. Concentrations of other substances are either staying the same, for example polyaromatic hydrocarbons (PAHs) and mercury, or increasing, such as polybrominated diphenyl ethers (PBDEs), used as flame retardants and other pollutants of emerging concern. While concentrations of some of these substances are very low at rural sites, they may be much higher in pollution "hotspots" - typically in urban areas.

Atmospheric deposition of toxic compounds is likely to continue into the future. Further reductions in emissions are necessary to

Concentration of PCBs as Measured in the Atmosphere of the Great Lakes Basin



Source: State of the Great Lakes 2005 report

reduce the concentrations of contaminants in the air and their deposition into the Great Lakes.

As PCB and DDT contaminant levels diminish, the number and frequency of **fish consumption advisories** for these chemicals is expected to decrease. Mercury concentrations, however, will continue to be a cause for fish consumption advisories in the Great Lakes basin. Lake Superior has the least restrictive fish consumption advisories: coho salmon may be consumed in unlimited quantities. In Lakes Michigan, Huron and Erie, coho salmon consumption is limited to one meal per month. In Lake Ontario, consumption of no more than one meal every two months is advised. Ontario sport fish sampling indicates that contaminants in lake trout have also been reduced since the late 1970s and early 1980s when fish consumption of lake trout was completely restricted. Lake trout can be safely consumed in Lakes Superior and Huron at an amount of four meals per month and Lakes Erie and Ontario at an amount of two meals per month. No samples were collected from Lake Michigan under the Ontario sport fish sampling program.

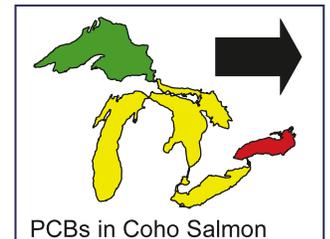


Photo Credit: U.S. Environmental Protection Agency, Great Lakes National Program Office

Contaminants such as certain brominated flame retardants, however, are increasing in the environment and the human health impacts related to these chemicals are not known.

Good	Fair	Poor	Mixed

Land Use-Land Cover

Total forest area has expanded across the Great Lakes basin in recent decades and previously contaminated urban areas (brownfields) are being revitalized. Development, land conversion and shoreline hardening, however, are occurring in ecologically sensitive areas of the basin, thereby threatening native habitats and species.



Photo Credit: U.S. Environmental Protection Agency, Great Lakes National Program Office

Forest area is increasing and is associated with positive impacts on water quality and quantity, such as reducing erosion, and thereby reducing the amount of sediment entering the water. Forests cover 27.8 million hectares, or about half (51 percent), of the land in the Great Lakes basin. The U.S. portion of the basin contains 14.8 million hectares or 36.6 million acres of forests (47 percent of the land in the U.S. basin), while the Canadian portion contains 13 million hectares or approximately 32 million acres (57 percent of the land in the Canadian basin).



Source: State of the Great Lakes 2005 report



Photo Credit: Société du Havre de Montréal

Brownfields are abandoned, idled or under-used industrial and commercial facilities where expansion, redevelopment or reuse is complicated by real or perceived environmental contamination. All eight Great Lakes States, Ontario and Quebec have programs to promote remediation or “clean up” and redevelopment of brownfields sites but not all jurisdictions track brownfields activities, and methods vary where tracking does occur. Information on hectares of brownfields remediated from Illinois, Minnesota, New York, Ohio, Pennsylvania and Quebec indicate that, as of 2002, a total of 13,000 hectares (32,124 acres) have been remediated in these states and province alone. Available data in 2002 from the eight Great Lakes states and Quebec indicate that more than 24,000 brownfield sites have participated in clean-up programs since the mid-1990s, although the degree of “remediation” varies considerably.

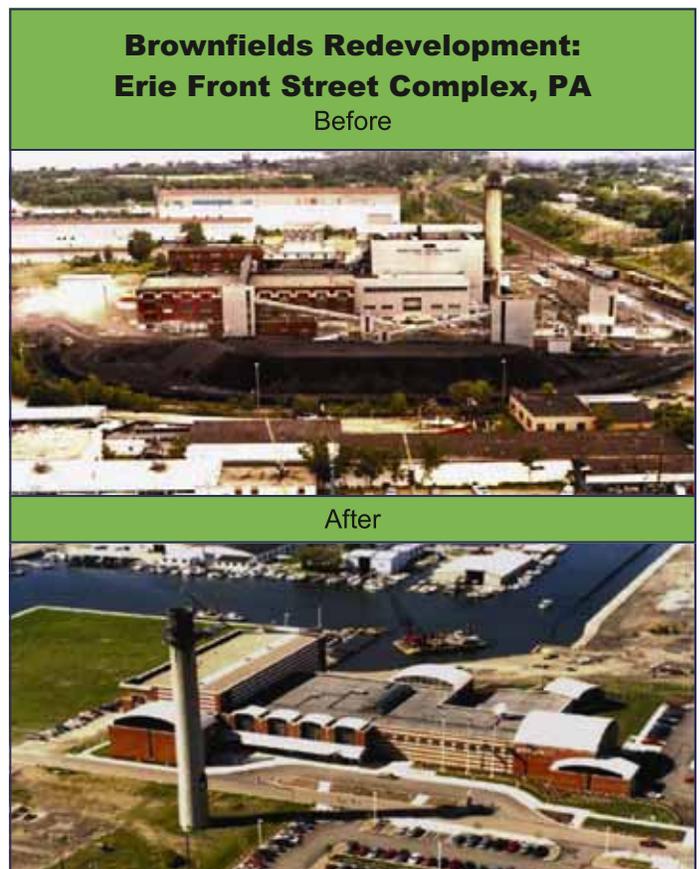
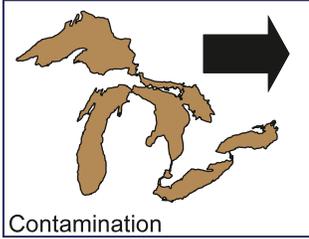


Photo Credit: Pennsylvania Department of Environmental Protection

Contamination



Contamination

Over the last 30 years, a decrease in the amount of contaminants in the Great Lakes suggests overall improvement. There is a marked reduction in levels of toxic chemicals in air, water, biota and sediments. However, many indicator species still contain levels of contaminants above established guidelines.

Historically regulated contaminants such as PCBs, DDT and mercury have declined in most fish species that are monitored. However, contaminants in aquatic invasive species are of major concern. Non-native zebra and quagga mussels are thought to alter the pathways and fate of persistent toxic substances, possibly changing the contamination accumulation pattern among fish - particularly for top predator fish. Although concentrations of many contaminants have decreased in fish tissue, **fish consumption advisories** continue to be in effect for PCBs, mercury and other contaminants.



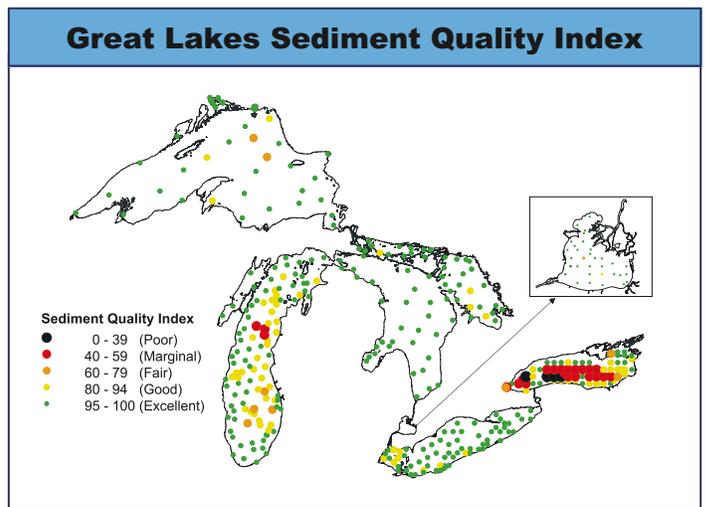
Snapping Turtle

Snapping turtles are a very useful biological indicator species of local wetland contaminants and the effects of these contaminants on wetland communities throughout the lower Great Lakes basin. Although there is evidence that some sites near or at Areas of

Photo Credit: Canadian Wildlife Service

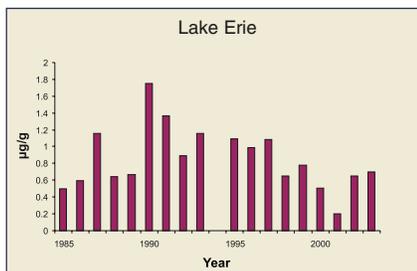
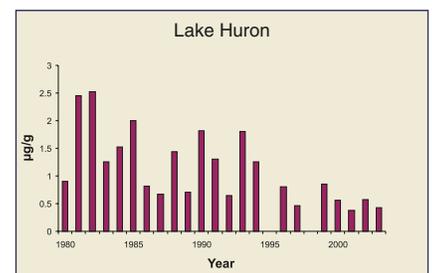
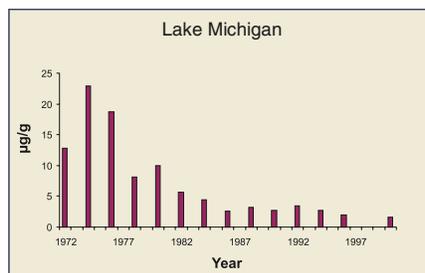
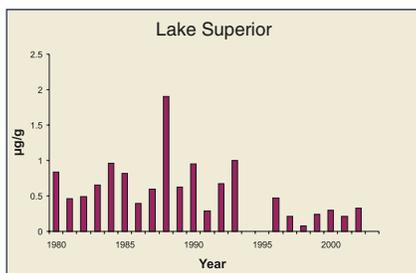
Concern (AOCs) experienced declines in total PCBs, contamination in snapping turtle eggs continues to exceed the Canadian Environmental Quality Guidelines. Remediation of sediments in some AOCs is beginning to address historical sources of contamination to the Great Lakes.

The Sediment Quality Index (SQI) is based on five metals: lead, zinc, copper, cadmium and mercury. The trend in sediment quality for these metals is generally indicative of trends for a wider range of persistent toxic chemicals. Areas of Lakes Erie, Ontario and Michigan show the poorest SQI scores as a result of historical urban and industrial activities.

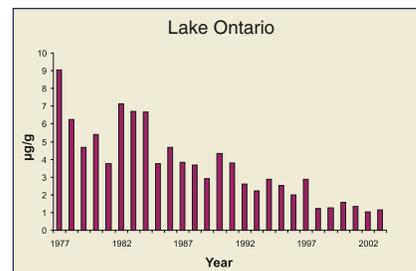


Source: State of the Great Lakes 2005 report

PCBs in Whole Lake Trout



Source: State of the Great Lakes 2005 report



Data from the long-term monitoring of herring gull eggs show that the levels of most contaminants are continuing to decline at a constant rate. However, even at current contaminant levels, more physiological abnormalities, such as a male-biased sex ratio of hatchlings and feminization in more than 10 percent of adult males, are being found in herring gulls at Great Lakes AOCs compared to sites outside of the Great Lakes basin.

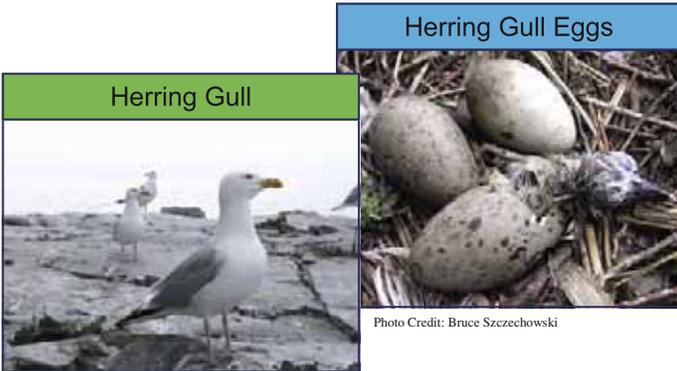
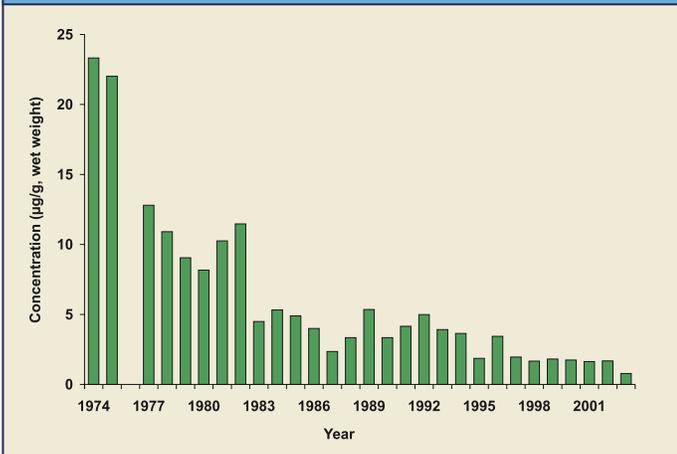


Photo Credit: Bruce Szczechowski

Trends in Concentrations of DDE in Herring Gull Eggs Toronto Harbour, Ontario



Source: State of the Great Lakes 2005 report

Chemicals of emerging concern, such as brominated flame retardants, are increasing in some biota. These compounds have increased dramatically in herring gull eggs over the past 20 years. More research is needed to help us understand the effects that these chemicals have on the health of the ecosystem and all of its inhabitants.



Large quantities of PAHs and metals continue to be released, especially near large population centres. Future reductions in the emissions of contaminants may decelerate as management efforts are offset by the consequences of population growth and urban sprawl, such as increased vehicle emissions.

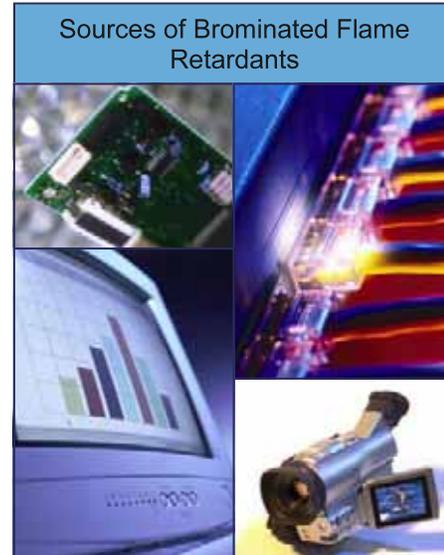
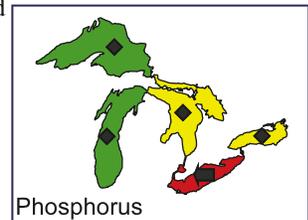
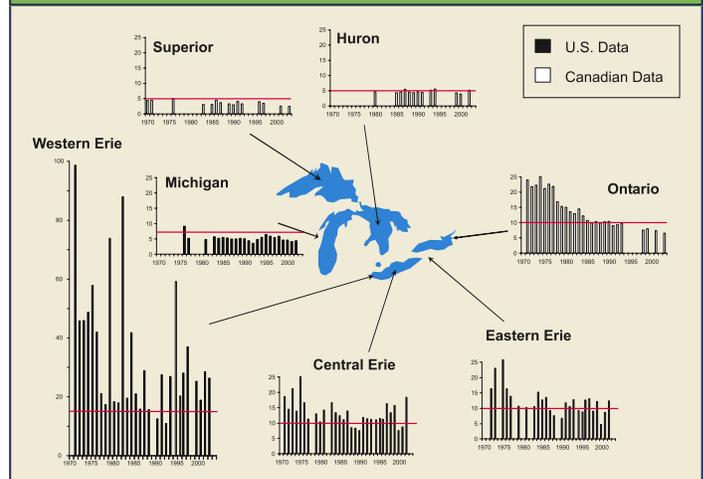


Photo Credit: Microsoft Office Clip Art.
<http://office.microsoft.com/clipart/default.aspx?lc=en-us>

Phosphorus was a major concern in the 1960s and 1970s, but concerted government action has led to the attainment of guideline levels for phosphorus in all Great Lakes except Lake Erie. Management activities, such as the removal of phosphorus from the discharge of large wastewater treatment plants, the restrictions on the amount of soluble phosphorus in laundry detergents and the control of agricultural run-off through no-till farming practices, resulted in the reduction of phosphorus in the Great Lakes.



Total Phosphorus Trends in the Great Lakes from 1970 to 2003 (µg/L)

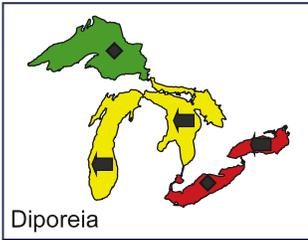


Source: State of the Great Lakes 2005 report

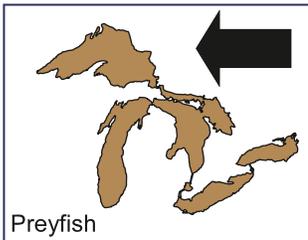
Biotic Communities

Populations of native benthic species such as *Diporeia* and freshwater mussels seem to be in decline. Predation on lake trout by sea lamprey in Lake Huron, deterioration of preyfish populations and thiamine deficiency in salmonids feeding on alewife are contributing to declines in other fish species. Populations of some amphibian and wetland-dependent bird species have generally declined. However, *Hexagenia* populations may be improving in some areas and some species of fish are showing signs of reproductive recovery.

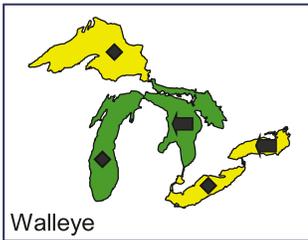
Diporeia populations have dramatically declined in Lakes Michigan, Huron and Ontario. Diporeia are small shrimp-like organisms that are fed upon by many forage fish. Declines in Diporeia and other native benthic populations appear to be related to increasing populations of non-native species. This decline has affected the condition and abundance of whitefish.



Diporeia



Preyfish



Walleye

Overall, **preyfish** abundance has declined in all the lakes. Predation by salmon and trout and the collapse of Diporeia are influencing preyfish populations.

Despite recent declines in **walleye** yields, environmental conditions have improved relative to the 1970s. Degradation and loss of adequate spawning and nursery habitats, and the presence of non-native species such as zebra and quagga mussels, are continuing to stress walleye populations.

Several species of birds that are dependent on coastal wetlands for feeding and/or nesting are showing basinwide population declines, including the black tern, marsh wren and least bittern. Declines may be in part due to wetland habitat conditions. Populations of some amphibian species have generally declined, including the American toad, chorus frog, green frog and northern leopard frog. Anecdotal and



Photo Credit: D. Menke, U.S. Fish and Wildlife Service



Photo Credit: http://www.glf.cfs.nrcan.gc.ca/landscape/herp_e.html



Photo Credit: E. and P. Bauer, U.S. Fish and Wildlife Service

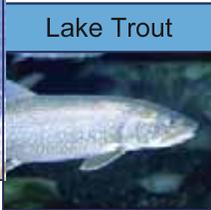
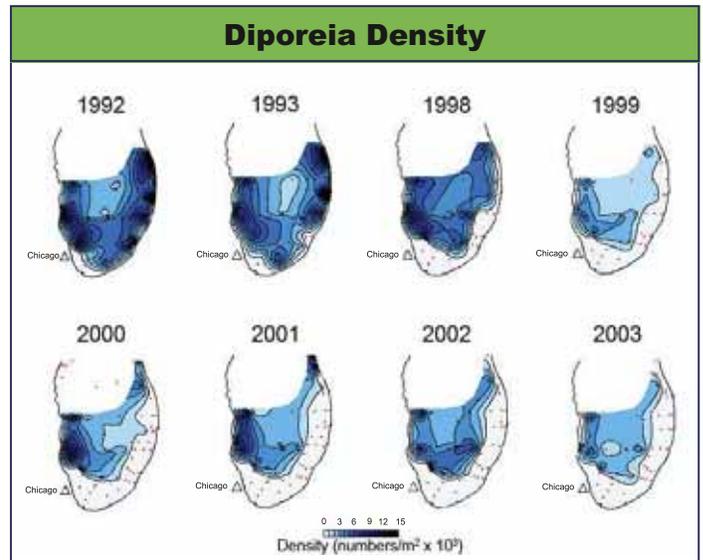


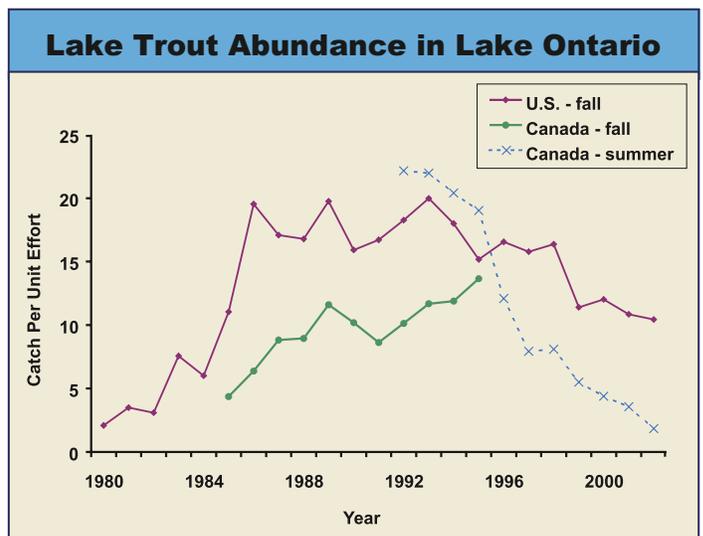
Photo Credit: E. Engbretson, U.S. Fish and Wildlife Service



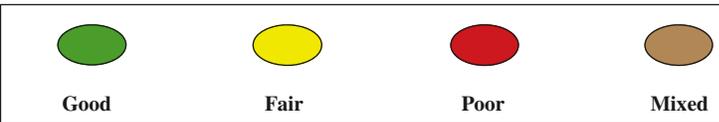
Source: State of the Great Lakes 2005 report

research evidence suggest that wide variations in the occurrence of many amphibian species at a given site are a natural and ongoing phenomenon. For both the wetland-dependent birds and amphibians, additional years of data will help distinguish whether declines in these species indicate significant long-term trends or simply a natural variation in population size.

Some populations of fish species, however, are improving. Lake trout reproduction in Lake Superior is self-sustaining and is increasing in Lake Ontario. Yellow perch populations in Lake Erie remain high. Forage species such as bloaters and herring are showing signs of recovery. Populations of lake sturgeon appear to be improving. Also, some species of wetland birds are showing increases in population, including willow fly catcher, common yellowthroat and mallard. These birds are generalists or prefer the habitat along wetland edges.



Source: State of the Great Lakes 2005 report



Invasive Species

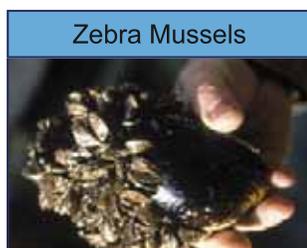
Activities associated with shipping are responsible for more than half the aquatic non-native invasive species introductions to the Great Lakes. Total numbers of invasive species introduced and established in the Great Lakes have increased steadily since the 1830s. However, numbers of ship-introduced invasive species have increased exponentially during the same time period.

Since the opening of the St. Lawrence Seaway in 1959, release of contaminated ballast water by **transoceanic ships** has been implicated in more than 70 percent of the introductions of non-native animal species in the Great Lakes. Non-native invasive species such as zebra and quagga mussels continue to impact the food web detrimentally. The growth of industries such as aquaculture, live food markets and aquarium retail stores is increasing the risk of non-native species introduction.



Transoceanic Ship

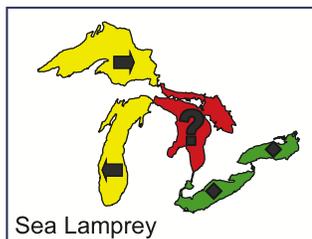
Photo Credit: U.S. Environmental Protection Agency, Great Lakes National Program Office



Zebra Mussels

Photo Credit: U.S. Fish and Wildlife Service

Sea lamprey almost eliminated lake trout from all Great Lakes waters before control efforts began in the 1960s. With the exception of Lake Huron, these controls have been effective in maintaining sea lamprey populations within acceptable limits to allow for successful rehabilitation of lake trout. Newly discovered populations of sea lamprey, from the Manistiquet River, have contributed to the increase in sea lamprey abundance in Lake Michigan.



Sea Lamprey



Sea Lamprey on Lake Trout

Photo Credit: U.S. Environmental Protection Agency, Great Lakes National Program Office



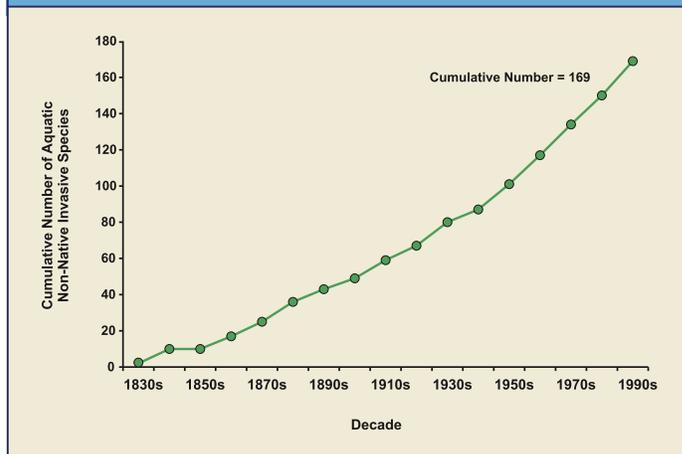
Sea Lamprey

Photo Credit: U.S. Environmental Protection Agency, Great Lakes National Program Office



Cumulative Number of Aquatic Non-native Invasive Species

Established in the Great Lakes Basin Since the 1830s



Source: State of the Great Lakes 2005 report

Type E botulism can cause mortality in fish and fish-eating birds. Live fish, especially non-native round goby, could be the transfer link for this toxin to water birds. Infected fish display loss of equilibrium and surface breaching, becoming more susceptible to capture by avian predators.

Although it is believed that only a small percentage of non-native species introduced to terrestrial ecosystems pose human health, environmental or economic hazards, this small percentage of successful terrestrial non-native species can have large impacts on the ecosystem. The Asian long-horned beetle, for example, is one non-native invasive species responsible for the demise of hardwood trees in Chicago, Toronto and other locations in the Great Lakes basin.



Purple Loosestrife

Photo Credit: U.S. Environmental Protection Agency, Great Lakes National Program Office



Asian Long-horned Beetle

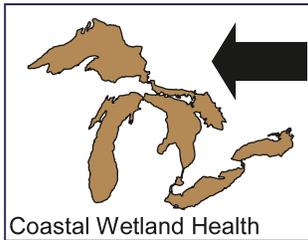
Photo Credit: J. Appleby, U.S. Fish and Wildlife Service

Aquatic Habitats and Coastal Zones

Aquatic habitats continue to deteriorate, especially in the nearshore. Unique structures, such as reefs, need more and consistent protection. Nearshore habitats are being degraded due to development, shoreline hardening and non-native invasive species. Wetlands continue to be lost and degraded. As well as providing habitat and feeding areas for many species of birds, amphibians and fish, wetlands also provide a refuge for native fish from the non-native ruffe and provide refuge for native mussels from non-native zebra mussels.

Water level controls have resulted in a decrease of coastal wetland area and a lower diversity of native species. Degradation of coastal wetlands from nutrients and sedimentation continues to threaten invertebrates, some native fish species, marsh birds and amphibians. Coastal wetlands of northern Lakes Michigan and Huron generally have relatively high quality fish and invertebrate communities.

Coastal wetlands totalling 216,743 hectares (535,584 acres) have been identified along the Great Lakes and connecting rivers through to Cornwall, Ontario. Despite significant loss of coastal wetland habitat in some regions of the Great Lakes, the lakes and connecting rivers still support a diversity of wetland types including barrier protected, drowned rivermouth and protected embayment coastal wetlands.



Shoreline hardening is resulting in the depletion of sediment for shoreline nourishment and the loss of nearshore aquatic habitats. Shorelines are hardened to prevent loss during high-water events and to increase shoreline stability for shipping, recreation and other uses. The connecting channels have the greatest percentage of shoreline hardening: St. Clair River (69 percent), Niagara River (44 percent) and St. Lawrence Seaway (12.6 percent).



Photo Credit: Environment Canada

Lake Superior has the largest **cobble shoreline** of all the Great Lakes with 960 kilometres (595 miles) of cobble beaches. This shoreline type provides habitat for rare plant species, including the Lake Huron tansy, redroot and heart-leaved plantain. Cobble beaches are the type of coastal habitat most frequently threatened and lost to shoreline development.



Photo Credit: U.S. Environmental Protection Agency, Great Lakes National Program Office



Photo Credit: U.S. Environmental Protection Agency, Great Lakes National Program Office



Photo Credit: Steve Olson, USDA-NRCS PLANTS Database



Photo Credit: U.S. Environmental Protection Agency, Great Lakes National Program Office



Resource Utilization

Although water withdrawals have decreased, overall energy consumption is increasing as population increases along the shoreline. Human population growth will lead to an increase in use of natural resources.

The shutdown of nuclear power facilities and the advances in water efficiency at thermal power plants have contributed to a decrease in **water withdrawals** since 1980. In 2000, water was withdrawn from the Great Lakes basin at a rate of more than 174,000 cubic metres (46 billion gallons) per day, with almost 80 percent of the energy supplying thermoelectric and industrial users. Public water systems accounted for about 13 percent of the total use.



Power Plant

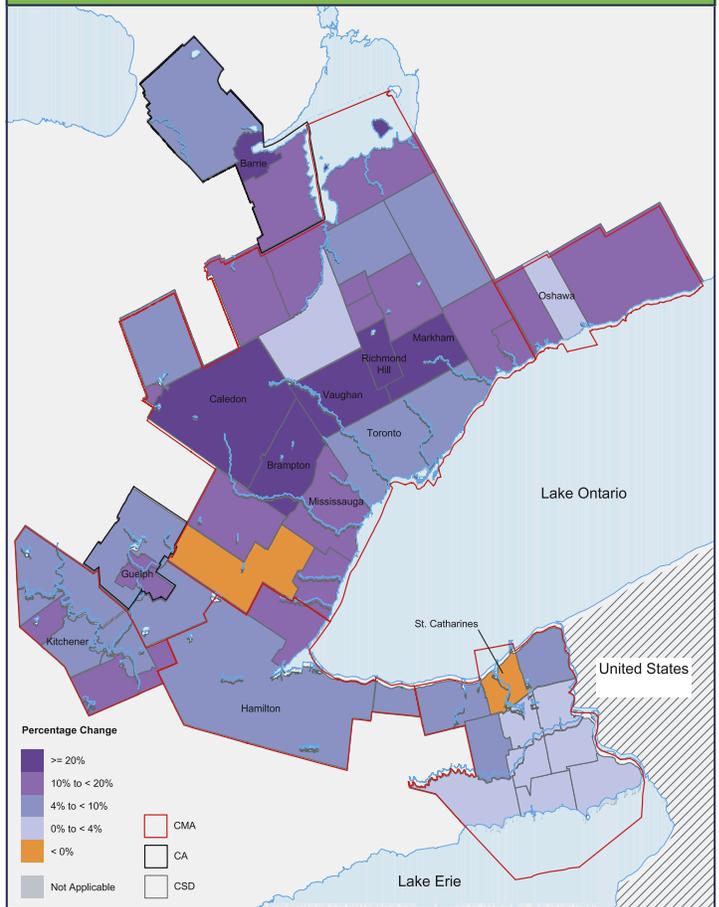
Photo Credit: U.S. Environmental Protection Agency, Great Lakes National Program Office

Data from 2000 indicate that in Ontario, the per capita **energy consumption** increased by 2 percent between 1999 and 2000, whereas in the U.S., per capita consumption decreased by an average of 0.9 percent. Energy demand in Ontario is expected to grow at an average annual rate of 1.3 percent between 1995 and 2020.

On the Canadian side of the Lake Ontario basin, the population in 2000 was 7.4 million. By 2030 it is projected that in excess of **three million more people** will live in this region, an increase of 43 percent, with most of the growth concentrated at the western end of Lake Ontario, within the Golden Horseshoe. Without conservation measures, there will be increased resource use as well as loss of habitat and prime agricultural lands due to development.

Population Change for the Extended Golden Horseshoe, Western Lake Ontario

1996-2001 by 2001 Census Subdivision



Source: Statistics Canada Census, http://geodepot.statcan.ca/Diss/Maps/ThematicMaps/Population/Regional/Horseshoe_popchg_E.pdf, July 20, 2005.

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Climate Change

Although it is accepted that climate change is occurring in the Great Lakes, trend information is incomplete.

Trends on each of the five lakes show that from the 1970s to the 1990s the maximum amount of ice forming each year has been decreasing. There was at least a 10 percent decline in the maximum ice cover on each lake, and almost 18 percent in some cases, with the greatest decline occurring during the 1990s.

Milder winters will have an important effect on the amount of ice cover on the lakes. The freezing and thawing of lakes is a very important process for aquatic and terrestrial ecosystems.

Many animals and fish rely on ice cover for protection and food acquisition. Ice cover also prevents excessive evaporation during winter, thus reducing lake-effect snow falls near the lakes.



Photo Credit: U.S. Environmental Protection Agency, Great Lakes National Program Office



Great Lakes and Rivers

In the **Lake Superior** basin, bald eagles, grey wolf and cormorants have recovered. Forest land cover has increased. Fisheries appear to be recovering well. However, invasive species continue to be a problem and remain a threat to the recovering fish populations. Stressors to the Lake Superior ecosystem include shoreline development, habitat loss, land use change and chemicals of emerging concern.



Bald Eagle

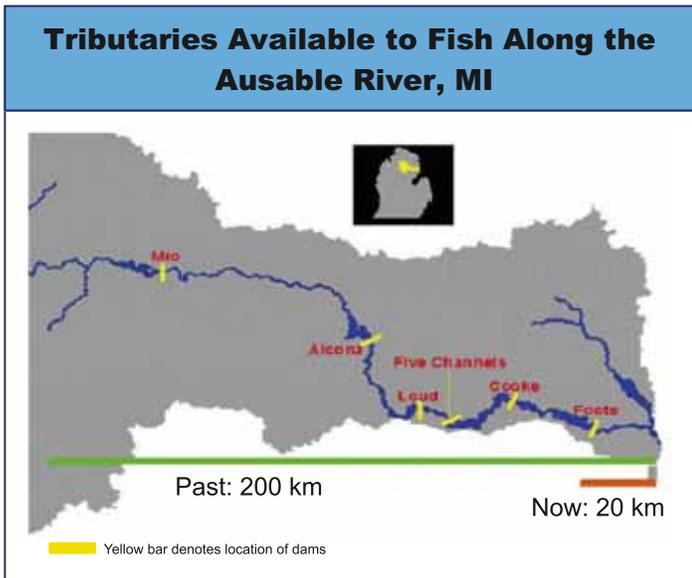
Photo Credit: M. Lockart, U.S. Fish and Wildlife Service



Grey Wolf

Photo Credit: T. Brooks, U.S. Fish and Wildlife Service

In **Lake Huron**, loss of coastal wetland habitats and shoreline alteration continues to occur as a result of development. Habitat degradation has occurred primarily through sedimentation of coastal wetlands and bays. Construction of dams has fragmented tributary habitat as can be seen in the Ausable River basin, Michigan. In the past (green line), more than 200 kilometres of the river were available for fish habitat. Dams now limit fish passage to only 20 kilometres of the river (orange line).



Source: Michigan Department of Natural Resources

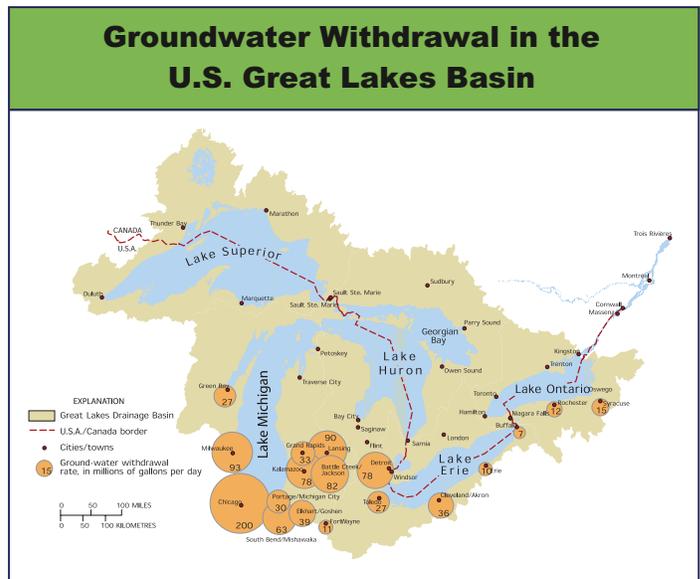
Because of an engineered connection between the Mississippi River and **Lake Michigan** drainage basins, the bighead carp now represents one of the most dramatic (but, fortunately, not yet established) food web threats to Lake Michigan. It is an invasive species that was reported to have escaped from aquaculture ponds adjacent to the Mississippi River in the 1980s and the 1990s. This large carp species, which weighs up to 40 kilograms (90 pounds), is considered a major threat to the entire Great Lakes food web.



Bighead Carp

Photo Credit: K. Westphal, U.S. Fish and Wildlife Service

The largest human-induced stresses on groundwater are pumping from wells for water supply and various forms of drainage, such as tile drains, which reduce recharge to the groundwater. Withdrawal of groundwater in the Lake Michigan watershed totals about one-third of surface water withdrawal.



Source: M. Greenwood, U.S. Geological Survey

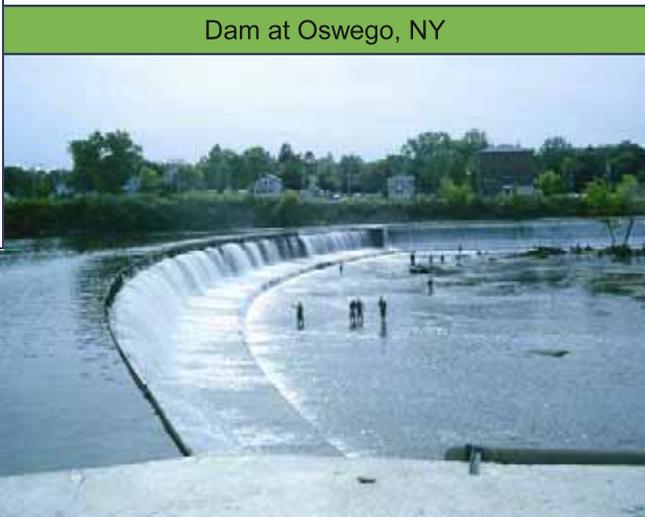


Photo Credit: U.S. Environmental Protection Agency, Great Lakes National Program Office

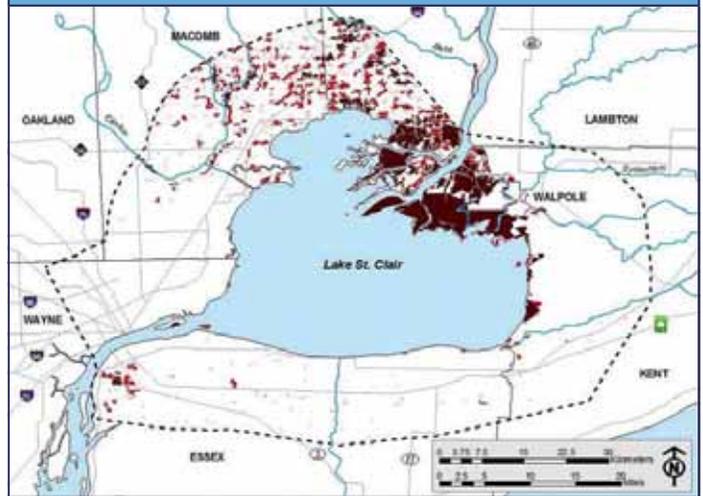
Land use continues to be one of the key stressors in the **St. Clair River-Lake St. Clair-Detroit River** ecosystem. As a result of land use changes and population increases, especially on the U.S. side, the loss of native habitats continues. However, many stakeholders throughout this ecosystem are actively pursuing actions to protect and restore key habitat areas. Contaminant concentrations have been generally decreasing over time. Contaminant inputs throughout the system, however, are resulting in a net increase in contaminant concentrations from the head of the St. Clair River to the outlet of the Detroit River.

Nutrient and sediment inputs to **Lake Erie** tributaries have been reduced by as much as 50 percent in some instances. However, some tributaries are still overwhelmed with sediment and nutrients by the time they reach the lake. This load of sediments and nutrients has contributed to the low oxygen condition in the central basin, making this area unsuitable for many organisms. Nearshore, improved water transparency has allowed for the resurgence of aquatic vegetation in coastal habitats, providing benefits to many fish and wildlife species. Transparency changes are also responsible for the resurgence of *Cladophora* (a filamentous algal species) in the eastern and central basins. *Cladophora* fouls spawning shoals and beaches and is a poor food source for invertebrates and other organisms. Decomposing *Cladophora* is also thought to be one of many contributors to the environmental conditions that caused outbreaks of avian botulism in the eastern basin from 1999-2002.

Evidence suggests that the management of lake levels has inadvertently reduced the area, quality and functioning of **Lake Ontario** nearshore wetlands. Regulated water levels have affected the natural range, frequency, timing and duration of water level changes in coastal wetlands and, in turn, reduced the extent and diversity of wetland communities and altered habitat quality for wetland animals. The low levels of variations in water levels are thought to have led to cattail dominance and reduced species diversity.

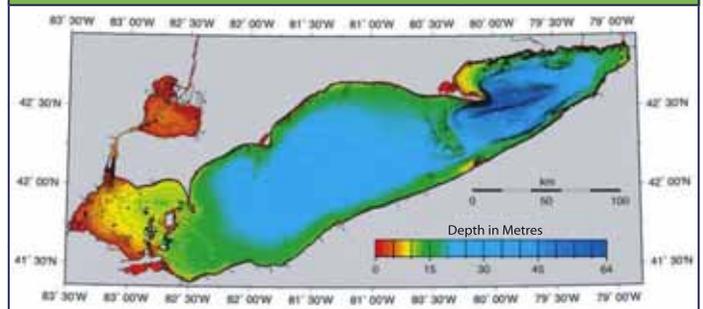
In the **St. Lawrence River**, from Cornwall to the downstream end of Montreal Island, approximately 80 percent of the shores are hardened and 20 percent are natural, while the reverse situation occurs from Montreal Island down to the outlet of Lake St. Pierre, where 80 percent of the shores are natural. Downstream to Quebec City, the ratio of hardened/natural shores is 40:60. The most severe erosion is observed on the islands between Montreal and Lake St. Pierre. This erosion is due mostly to navigation. Despite the major structural changes to its ecosystems, the St. Lawrence River has shown a strong resilience and still shelters very productive habitats and diversified plant and animal species.

Potential Conservation Areas within the Lake St. Clair Basin



Source: Michigan Natural Features Inventory

Bathymetry of Lake Erie and Lake St. Clair



Source: State of the Great Lakes 2005 report

Wetland Cattails



Photo Credit: John Hall, Hamilton Harbour RAP

St. Lawrence River: Technoparc Area, Montreal



Photo Credit: Société du Havre de Montréal

State of the Lakes Ecosystem Conference

The State of the Lakes Ecosystem Conferences (SOLEC) are hosted by the U.S. Environmental Protection Agency and Environment Canada on behalf of the two countries. These conferences are held every two years in response to a reporting requirement of the binational Great Lakes Water Quality Agreement (GLWQA). The purpose of the Agreement is “*to restore and maintain the physical, chemical and biological integrity of the Great Lakes Basin.*”

The conferences provide independent, science-based reporting on the state of the health of the Great Lakes basin ecosystem every two years.

Four objectives were established for the State of the Lakes Ecosystem Conferences:

- To assess the state of the Great Lakes ecosystem based on accepted indicators;
- To strengthen decision-making and environmental management concerning the Great Lakes;
- To inform local decision makers of Great Lakes environmental issues; And,
- To provide a forum for communication and networking amongst all the Great Lakes stakeholders.

The role of SOLEC is to provide clear, compiled information to the Great Lakes community to enable environmental managers to make better-informed decisions. Although SOLEC is primarily a reporting venue rather than a management program, many SOLEC participants are involved in decision-making processes throughout the Great Lakes basin.



For more information about Great Lakes indicators and the State of the Lakes Ecosystem Conference, visit:

www.binational.net

or

www.epa.gov/glnpo/solec

State of the Great Lakes 2005 Highlights

*by the Governments of
Canada
and
The United States of America*

*Prepared by
Environment Canada
and the
U.S. Environmental Protection Agency*

